Introduction - Earth Science

The following released test questions are taken from the Earth Science Standards Test. This test is one of the California Standards Tests administered as part of the Standardized Testing and Reporting (STAR) Program under policies set by the State Board of Education.

All questions on the California Standards Tests are evaluated by committees of content experts, including teachers and administrators, to ensure their appropriateness for measuring the California academic content standards in Earth Science. In addition to content, all items are reviewed and approved to ensure their adherence to the principles of fairness and to ensure no bias exists with respect to characteristics such as gender, ethnicity, and language.

This document contains released test questions from the California Standards Test forms in 2003, 2004, and 2005. First on the pages that follow are lists of the standards assessed on the Earth Science Test. Next are released test questions. Following the questions is a table that gives the correct answer for each question, the content standard that each question is measuring, and the year each question last appeared on the test. It should be noted that asterisked (*) standards found in the *Science Content Standards for California Public Schools, Kindergarten through Grade 12*, are not assessed on the California Standards Tests in Science and, therefore, are not represented in these released test questions.

The following table lists each reporting cluster, the number of items that appear on the exam, and the number of released test questions that appear in this document. The released test questions for Biology, Chemistry, Earth Science, and Physics are the same test questions found in different combinations on the Integrated Science 1, 2, 3, and 4 tests.

Earth Science — Released Test Questions

REPORTING CLUSTER	NUMBER OF QUESTIONS ON EXAM	NUMBER OF RELEASED TEST QUESTIONS
Investigation and Experimentation (Standards: ESIE1. a-n)	6	4
Astronomy and Cosmology *Earth's Place in the Universe* (Standards: ES1. a-f, ES2. a-d)	12	10
Solid Earth *Dynamic Earth Processes* (Standards: ES3. a-e) *California Geology* (Standards: ES9. a-c)	14	12
The Earth's Energy *Energy in the Earth System* (Standards: ES4. a-c, ES5. a-e, ES6. a-c) *Biogeochemical Cycles* (Standards: ES7. a-c) *Structure and Composition of the Atmosphere* (Standards: ES8. a-c)	28	19
TOTAL	60	45

In selecting test questions for release, three criteria are used: (1) the questions adequately cover a selection of the academic content standards assessed on the Earth Science Test; (2) the questions demonstrate a range of difficulty; and (3) the questions present a variety of ways standards can be assessed. These released test questions do not reflect all of the ways the standards may be assessed. Released test questions will not appear on future tests.

For more information about the California Standards Tests, visit the California Department of Education's Web site at http://www.cde.ca.gov/ta/tg/sr/resources.asp.

THE INVESTIGATION AND EXPERIMENTATION REPORTING CLUSTER

The following 14 California content standards are included in the Investigation and Experimentation reporting cluster and are represented in this booklet by four test questions. These questions represent only some ways in which these standards may be assessed on the California Earth Science Standards Test.

CALIFORNIA CONTENT STANDARDS IN THIS REPORTING CLUSTER

Investigation and Experimentation	
ESIE1.	**Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three reporting clusters, students should develop their own questions and perform investigations. Students will:**
ESIE1. a.	Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
ESIE1. b.	Identify and communicate sources of unavoidable experimental error.
ESIE1. c.	Identify possible reasons for inconsistent results, such as sources of error or uncontrolled conditions.
ESIE1. d.	Formulate explanations by using logic and evidence.
ESIE1. e.	Solve scientific problems by using quadratic equations and simple trigonometric, exponential, and logarithmic functions.
ESIE1. f.	Distinguish between hypothesis and theory as scientific terms.
ESIE1. g.	Recognize the usefulness and limitations of models and theories as scientific representations of reality.
ESIE1. h.	Read and interpret topographic and geologic maps.
ESIE1. i.	Analyze the locations, sequences, or time intervals that are characteristic of natural phenomena (e.g., relative ages of rocks, locations of planets over time, and succession of species in an ecosystem).
ESIE1. j.	Recognize the issues of statistical variability and the need for controlled tests.
ESIE1. k.	Recognize the cumulative nature of scientific evidence.
ESIE1. l.	Analyze situations and solve problems that require combining and applying concepts from more than one area of science.
ESIE1. m.	Investigate a science-based societal issue by researching the literature, analyzing data, and communicating the findings. Examples of issues include irradiation of food, cloning of animals by somatic cell nuclear transfer, choice of energy sources, and land and water use decisions in California.
ESIE1. n.	Know that when an observation does not agree with an accepted scientific theory, the observation is sometimes mistaken or fraudulent (e.g., the Piltdown Man fossil or unidentified flying objects) and that the theory is sometimes wrong (e.g., the Ptolemaic model of the movement of the Sun, Moon, and planets).

THE ASTRONOMY AND COSMOLOGY REPORTING CLUSTER

The following 10 California content standards are included in the Astronomy and Cosmology reporting cluster and are represented in this booklet by 10 test questions. These questions represent only some ways in which these standards may be assessed on the California Earth Science Standards Test.

CALIFORNIA CONTENT STANDARDS IN THIS REPORTING CLUSTER

Earth's Place in the Universe	
ES1.	**Astronomy and planetary exploration reveal the solar system's structure, scale, and change over time. As a basis for understanding this concept:**
ES1. a.	*Students know* how the differences and similarities among the sun, the terrestrial planets, and the gas planets may have been established during the formation of the solar system.
ES1. b.	*Students know* the evidence from Earth and moon rocks indicates that the solar system was formed from a nebular cloud of dust and gas approximately 4.6 billion years ago.
ES1. c.	*Students know* the evidence from geological studies of Earth and other planets suggests that the early Earth was very different from Earth today.
ES1. d.	*Students know* the evidence indicating that the planets are much closer to Earth than the stars are.
ES1. e.	*Students know* the Sun is a typical star and is powered by nuclear reactions, primarily the fusion of hydrogen to form helium.
ES1. f.	*Students know* the evidence for the dramatic effects that asteroid impacts have had in shaping the surface of planets and their moons and in mass extinctions of life on Earth.
ES2.	**Earth-based and space-based astronomy reveal the structure, scale, and changes in stars, galaxies, and the universe over time. As a basis for understanding this concept:**
ES2. a.	*Students know* the solar system is located in an outer edge of the disc-shaped Milky Way galaxy, which spans 100,000 light years.
ES2. b.	*Students know* galaxies are made of billions of stars and comprise most of the visible mass of the universe.
ES2. c.	*Students know* the evidence indicating that all elements with an atomic number greater than that of lithium have been formed by nuclear fusion in stars.
ES2. d.	*Students know* that stars differ in their life cycles and that visual, radio, and X-ray telescopes may be used to collect data that reveal those differences.

THE SOLID EARTH REPORTING CLUSTER

The following eight California content standards are included in the Solid Earth reporting cluster and are represented in this booklet by 12 test questions. These questions represent only some ways in which these standards may be assessed on the California Earth Science Standards Test.

CALIFORNIA CONTENT STANDARDS IN THIS REPORTING CLUSTER

Dynamic Earth Processes	
ES3.	**Plate tectonics operating over geologic time has changed the patterns of land, sea, and mountains on Earth's surface. As the basis for understanding this concept:**
ES3. a.	*Students know* features of the ocean floor (magnetic patterns, age, and sea-floor topography) provide evidence of plate tectonics.
ES3. b.	*Students know* the principal structures that form at the three different kinds of plate boundaries.
ES3. c.	*Students know* how to explain the properties of rocks based on the physical and chemical conditions in which they formed, including plate tectonic processes.
ES3. d.	*Students know* why and how earthquakes occur and the scales used to measure their intensity and magnitude.
ES3. e.	*Students know* there are two kinds of volcanoes: one kind with violent eruptions producing steep slopes and the other kind with voluminous lava flows producing gentle slopes.
California Geology	
ES9.	**The geology of California underlies the state's wealth of natural resources as well as its natural hazards. As a basis for understanding this concept:**
ES9. a.	*Students know* the resources of major economic importance in California and their relation to California's geology.
ES9. b.	*Students know* the principal natural hazards in different California regions and the geologic basis of those hazards.
ES9. c.	*Students know* the importance of water to society, the origins of California's fresh water, and the relationship between supply and need.

THE EARTH'S ENERGY REPORTING CLUSTER

The following 17 California content standards are included in The Earth's Energy reporting cluster and are represented in this booklet by 19 test questions. These questions represent only some ways in which these standards may be assessed on the California Earth Science Standards Test.

CALIFORNIA CONTENT STANDARDS IN THIS REPORTING CLUSTER

Energy in the Earth System	
ES4.	**Energy enters the Earth system primarily as solar radiation and eventually escapes as heat. As a basis for understanding this concept:**
ES4. a.	*Students know* the relative amount of incoming solar energy compared with Earth's internal energy and the energy used by society.
ES4. b.	*Students know* the fate of incoming solar radiation in terms of reflection, absorption, and photosynthesis.
ES4. c.	*Students know* the different atmospheric gases that absorb the Earth's thermal radiation and the mechanism and significance of the greenhouse effect.
ES5.	**Heating of Earth's surface and atmosphere by the sun drives convection within the atmosphere and oceans, producing winds and ocean currents. As a basis for understanding this concept:**
ES5. a.	*Students know* how differential heating of Earth results in circulation patterns in the atmosphere and oceans that globally distribute the heat.
ES5. b.	*Students know* the relationship between the rotation of Earth and the circular motions of ocean currents and air in pressure centers.
ES5. c.	*Students know* the origin and effects of temperature inversions.
ES5. d.	*Students know* properties of ocean water, such as temperature and salinity, can be used to explain the layered structure of the oceans, the generation of horizontal and vertical ocean currents, and the geographic distribution of marine organisms.
ES5. e.	*Students know* rain forests and deserts on Earth are distributed in bands at specific latitudes.
ES6.	**Climate is the long-term average of a region's weather and depends on many factors. As a basis for understanding this concept:**
ES6. a.	*Students know* weather (in the short run) and climate (in the long run) involve the transfer of energy into and out of the atmosphere.
ES6. b.	*Students know* the effects on climate of latitude, elevation, topography, and proximity to large bodies of water and cold or warm ocean currents.
ES6. c.	*Students know* how Earth's climate has changed over time, corresponding to changes in Earth's geography, atmospheric composition, and other factors, such as solar radiation and plate movement.

Biogeochemical Cycles	
ES7.	**Each element on Earth moves among reservoirs, which exist in the solid earth, in oceans, in the atmosphere, and within and among organisms as part of biogeochemical cycles. As a basis for understanding this concept:**
ES7. a.	*Students know* the carbon cycle of photosynthesis and respiration and the nitrogen cycle.
ES7. b.	*Students know* the global carbon cycle: the different physical and chemical forms of carbon in the atmosphere, oceans, biomass, fossil fuels, and the movement of carbon among these reservoirs.
ES7. c.	*Students know* the movement of matter among reservoirs is driven by Earth's internal and external sources of energy.
Structure and Composition of the Atmosphere	
ES8.	**Life has changed Earth's atmosphere, and changes in the atmosphere affect conditions for life. As a basis for understanding this concept:**
ES8. a.	*Students know* the thermal structure and chemical composition of the atmosphere.
ES8. b.	*Students know* how the composition of Earth's atmosphere has evolved over geologic time and know the effect of outgassing, the variations of carbon dioxide concentration, and the origin of atmospheric oxygen.
ES8. c.	*Students know* the location of the ozone layer in the upper atmosphere, its role in absorbing ultraviolet radiation, and the way in which this layer varies both naturally and in response to human activities.

1 **A day on Saturn takes about 10 Earth hours. Which fact would *best* explain this short day?**

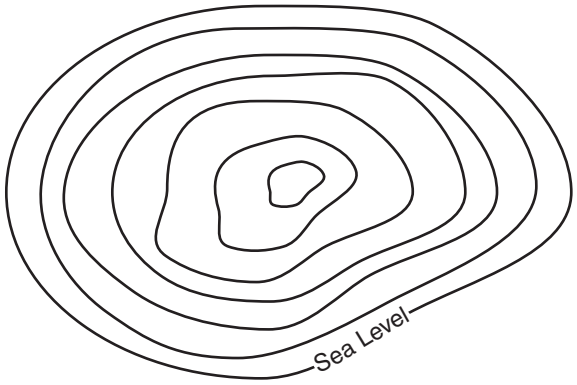
A Saturn is less dense than Earth.

B Saturn is much farther from the Sun than Earth.

C Saturn rotates more rapidly than Earth.

D Saturn's orbit has greater eccentricity than Earth's.

2



Contour Interval - 5 meters

The highest elevation on this topographic map can be no more than about

A 25 meters.

B 34 meters.

C 45 meters.

D 49 meters.

3 **In an area where a river has cut deep into Earth, there are several layers of very different rock exposed. The oldest rock layer is *most* likely to be the layer that is**

A below the other layers.

B the thickest layer.

C the most rich in fossils.

D igneous intrusive rock.

4 **The existence of extraterrestrial life may never be proven, but this idea will become more scientifically acceptable over time if**

A no one disputes this idea in a scientific forum.

B hypotheses are made related to the idea.

C alternative hypotheses are proposed and confirmed.

D increasing scientific evidence supports the idea.

5 **Which of the following statements *best* describes how the planets of the solar system formed?**

A They are condensed rings of matter thrown off by the young Sun.

B They are the remains of an exploded star once paired with the Sun.

C The Sun captured them from smaller, older nearby stars.

D They formed from a nebular cloud of dust and gas.

6 **Evidence suggests that Earth is about 4.6 billion years old, even though no Earth rocks have been found that can be dated at more than 4 billion years old. This discrepancy is *most* likely caused by Earth's original crust being**

A difficult to date so precisely.

B subject to extensive erosion.

C blasted away during Earth's formation.

D destroyed by solar radiation.

7 **Which of the following is the *best* evidence that Earth's continents were once in vastly different positions than they are today?**

A Penguins are found only in the Southern Hemisphere.

B Fossils of tropical plants are found in Antarctica.

C Volcanoes encircle the Pacific Ocean.

D Major rivers form deltas from continental erosion.

8 **Early telescopes showed stars as only points of light, while the planets appeared to be much larger, providing evidence that stars must**

A be more plentiful in our solar system than planets.

B travel in elliptical orbits like planets.

C be much farther from Earth than planets.

D reflect much more light than planets.

9 **What is the source of energy for the Sun?**

A hydrogen fusion

B internal combustion

C nuclear fission of metals

D burning of solar gases

10 **The surfaces of planet Mercury and our moon contain some very large craters that are *most* likely the result of**

A giant lava flows.

B asteroid impacts.

C nuclear explosions.

D large collapsed caves.

11 **The Sun is an average yellow star in the Milky Way galaxy, which is described as**

A a dwarf galaxy.

B a spiral galaxy.

C an elliptical galaxy.

D an irregular galaxy.

12 **As part of the modern theory of the origins of the elements, it is hypothesized that before the formation of the stars, most of the matter in the universe consisted of what atoms?**

A hydrogen and helium

B nitrogen and carbon

C silicon and lithium

D uranium and radium

13 **Stars begin their life cycle in**

A a black hole.

B a nova.

C a nebula.

D a supernova.

14 **Astronomers have discovered vast differences in stars through their observations. One theory used to explain these differences is that**

A the distances between stars are vast.

B stars are at different points in their life cycles.

C Earth's atmosphere distorts our view of the stars.

D there is too much light pollution on Earth to study stars.

15 **Which of the following provides evidence for plate tectonics?**

A sea-floor topography

B ocean currents

C Coriolis effect

D atmospheric temperatures

16 **A rift valley is evidence of which kind of plate boundary?**

A convergent

B divergent

C transform

D uniform

17 **The convergence of two continental plates would produce**

A island arcs.

B rift valleys.

C folded mountains.

D trenches.

18 **It is generally true that igneous rocks**

A contain primarily evaporites.

B can be scratched with a penny.

C normally contain fossils.

D are composed of silicate minerals.

19 **Earthquake vibrations are detected, measured, and recorded by instruments called**

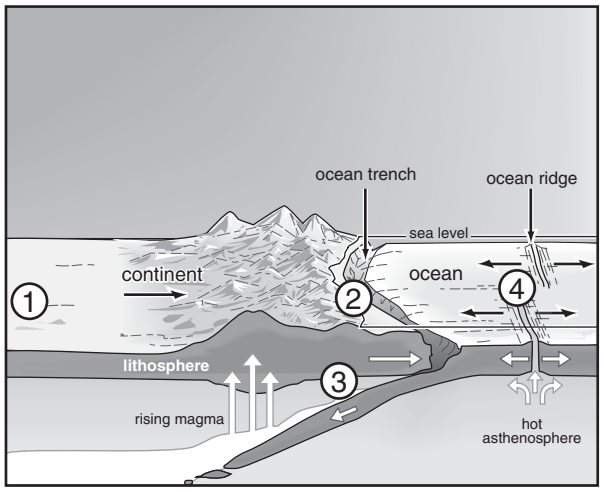
A sonargraphs.

B seismographs.

C Richter scales.

D magnetometers.

20



At which location would earthquakes be *least* likely to occur?

A 1

B 2

C 3

D 4

21 **Which type of volcano would be the *least* explosive?**

A cinder cone

B stratovolcano

C shield volcano

D composite cone

22 **Which of the following energy sources is *most* likely to be abundant in California due to its position on a plate boundary?**

A wind

B nuclear

C solar

D geothermal

23 **What energy resource is made possible by the volcanic activity in California?**

A hydroelectricity

B nuclear power

C geothermal energy

D solar energy

24 **The Long Valley Caldera in east-central California was formed by a massive volcanic eruption about 760,000 years ago. Since then, it has erupted several times. Of the following, which would be *least* likely to indicate that another eruption will soon occur?**

A recurring earthquakes in the vicinity

B decreases in precipitation in the area

C changes in gas emissions from the caldera

D uplifting of the floor of the caldera

25 **Earthquake activity in California is primarily caused by**

A the lowering of aquifer levels.

B the interaction of tides with the coast.

C mining activity during the nineteenth century.

D plates grinding past each other along active faults.

26 **The main purpose of the California aqueduct is to**

A allow inexpensive water routes for transporting commercial products.

B transport fresh water to areas with dense populations.

C divert floodwater from populated regions to sparsely populated areas.

D provide abundant ocean water to drier regions of California.

27 **Only about 50% of the solar energy directed toward Earth penetrates directly to the surface. What happens to the rest of the radiation?**

A It is absorbed or reflected by the atmosphere.

B It loses energy traveling through space.

C It is reflected off the Moon and back into space.

D It loses energy overcoming the Sun's gravity.

28 **The Moon is very hot on the side facing the Sun and very cold on the dark side. This extreme temperature difference is primarily due to the Moon's**

A mineral composition.

B thin atmosphere.

C reflective rocks.

D lack of volcanic activity.

29 **Which of these could increase average global temperatures?**

A increased use of fossil fuels

B increased ocean algal blooms

C decreased carbon dioxide emissions

D increased numbers of animal species

30 **The clouds that surround Venus are so thick that the planet actually absorbs less sunlight than the Earth. Nevertheless, Venus has a surface temperature of more than 400 °C. Which of these *best* explains this high surface temperature?**

A The bright surfaces of the clouds reflect sunlight back on the planet.

B The strong winds in the atmosphere produce friction.

C The thick clouds in the atmosphere prevent heat from escaping.

D The sulfuric acid in the clouds releases heat energy.

31 **More solar energy reaches the equatorial regions than the polar regions because the equatorial regions**

A are covered by a greater area of land.

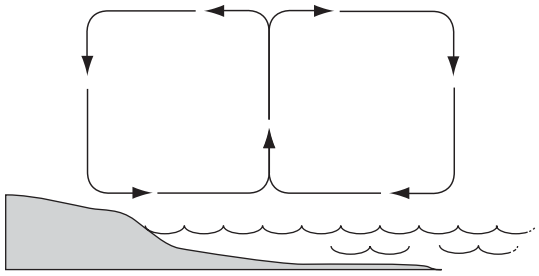
B have more vegetation to absorb sunlight.

C have days with more hours of light.

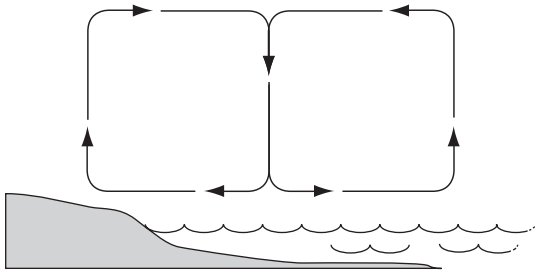
D receive sun rays closest to vertical.

32 **Which diagram *best* models the movement of coastal air during the afternoon?**

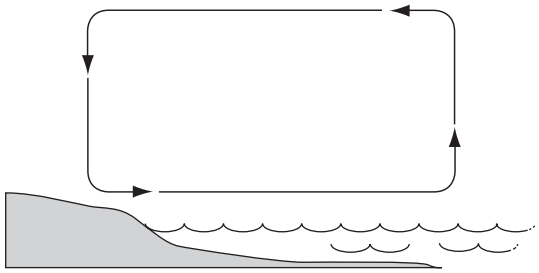
A



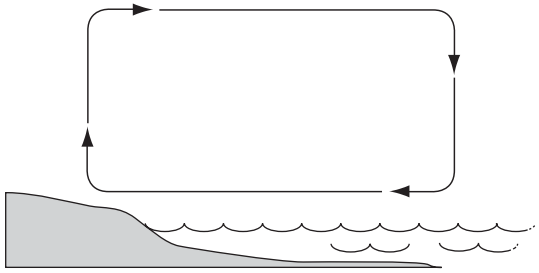
B



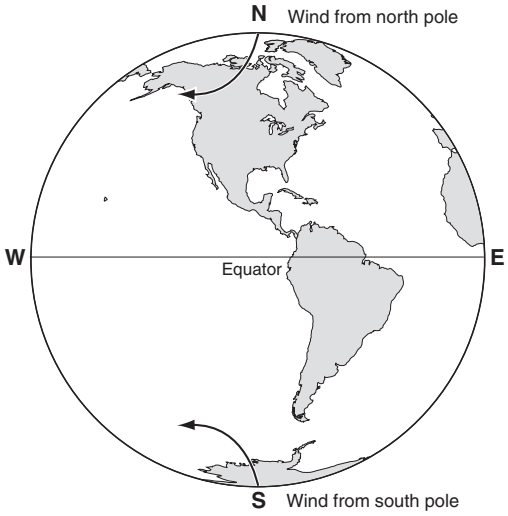
C



D



33



What causes the wind deflection from the north and south poles?

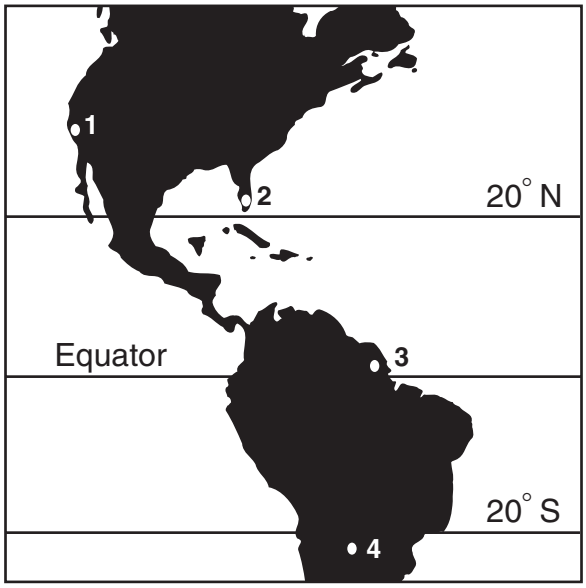
A the rotation of Earth on its axis

B the oblate shape of Earth

C the tilt of Earth's axis relative to its orbital plane

D the difference in total land mass of the two hemispheres

34



At which location on the map would a rain forest *most* likely be found?

A 1

B 2

C 3

D 4

35 **Which of these effects generally occurs as the result of a warm air mass and a cooler air mass converging at Earth's surface?**

A The sky becomes clear.

B Winds die down.

C Cloud formation decreases.

D Stormy weather patterns develop.

36 **Shifts in Earth's continents *most* likely caused a change in Earth's**

A climatic regions.

B mass.

C orbital velocity.

D atmospheric temperature.

37 **The Gulf Stream in the Northern Hemisphere and the Brazilian Current in the Southern Hemisphere move poleward. Compared to inland areas at the same latitude, the coastal areas bordering these currents will**

A be warmer.

B be more arid.

C have more advection fogs.

D have shorter growing seasons.

38 **Scientists have found fossils of tropical plants in Antarctica. How could tropical plants have grown in Antarctica?**

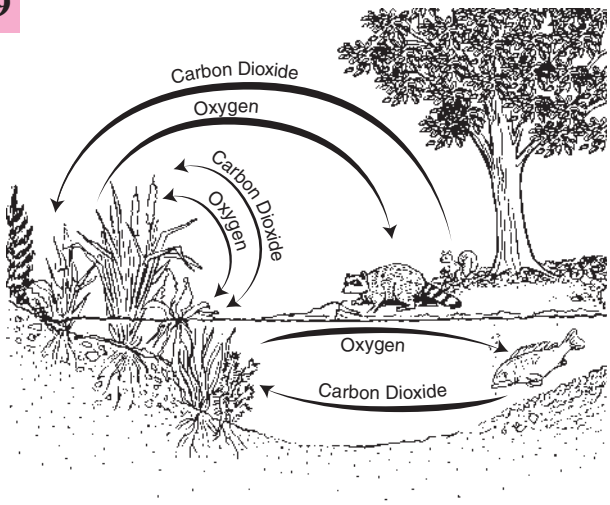
A At one time, Earth's entire surface was a tropical rain forest.

B At one time, Antarctica was located closer to the equator.

C The rotation of Earth has increased, causing cooling of the atmosphere.

D Catastrophic volcanic eruptions melted the ice and exposed the soil to sunlight.

39



Which of these statements is *best* illustrated by this diagram?

A Animals under water eat plants.

B Land animals exhale oxygen into water.

C Water-dwelling animals breathe carbon dioxide.

D Plants can take in carbon dioxide from air or water.

40 **From Earth's atmosphere, carbon dioxide is used by plants, algae, and cyanobacteria during the process of**

A photosynthesis.

B respiration.

C decomposition.

D nitrogen fixation.

41

Analysis of Gases From a Hawaiian Volcano

Gas	Amount
H_2O (steam)	79%
CO_2	12%
SO_2	6.5%
N_2	1.5%
H_2, CO, Cl_2, and Ar	trace

The table above lists the gases coming from a modern Hawaiian volcano. If ancient volcanoes gave off the same gases, which gas would have been *most* helpful in the development of early life-forms that could carry out photosynthesis?

A N_2

B SO_2

C CO_2

D Cl_2

42

Earth's atmosphere is divided into layers that are based upon their

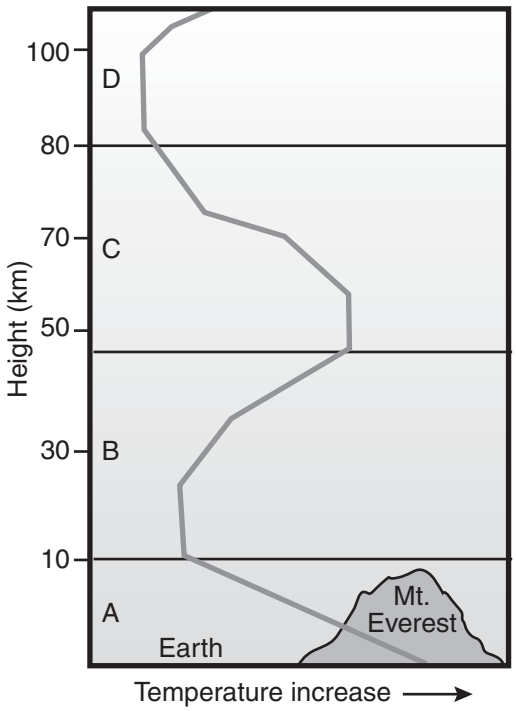
A water content.

B relative humidity.

C gas content.

D temperature gradient.

43



The diagram above shows four layers of Earth's atmosphere. Which of the following correctly labels the layers represented by A, B, C, and D (from Earth moving upward) in the correct sequence?

A troposphere, stratosphere, mesosphere, thermosphere

B thermosphere, mesosphere, stratosphere, troposphere

C troposphere, mesosphere, thermosphere, stratosphere

D mesosphere, troposphere, thermosphere, stratosphere

44 **The primitive atmosphere of Earth was deficient in free oxygen. What process was primarily responsible for the development of the present percentage of free oxygen in the Earth's atmosphere?**

A outgassing

B photosynthesis

C volcanic eruptions

D oxidation of iron-based minerals

45 **Which of the following human activities reduces the level of ozone in the atmosphere?**

A using artificial lighting in scientific polar stations

B using large banks of solar cells for energy production

C releasing chlorofluorocarbons from aerosol cans

D destroying large areas of the equatorial rain forests

Question Number	Correct Answer	Standard	Year of Test
1	*C*	ESIE1.D	2004
2	*B*	ESIE1.H	2003
3	*A*	ESIE1.I	2004
4	*D*	ESIE1.K	2005
5	*D*	ES1.A	2005
6	*B*	ES1.B	2004
7	*B*	ES1.C	2003
8	*C*	ES1.D	2004
9	*A*	ES1.E	2003
10	*B*	ES1.F	2004
11	*B*	ES2.A	2003
12	*A*	ES2.C	2005
13	*C*	ES2.D	2004
14	*B*	ES2.D	2005
15	*A*	ES3.A	2003
16	*B*	ES3.B	2004
17	*C*	ES3.B	2004
18	*D*	ES3.C	2005
19	*B*	ES3.D	2003
20	*A*	ES3.D	2004
21	*C*	ES3.E	2005
22	*D*	ES9.A	2003
23	*C*	ES9.A	2005
24	*B*	ES9.B	2004
25	*D*	ES9.B	2005
26	*B*	ES9.C	2004

Question Number	Correct Answer	Standard	Year of Test
27	*A*	ES4.A	2005
28	*B*	ES4.B	2003
29	*A*	ES4.C	2004
30	*C*	ES4.C	2005
31	*D*	ES5.A	2003
32	*D*	ES5.A	2004
33	*A*	ES5.B	2003
34	*C*	ES5.E	2005
35	*D*	ES6.A	2004
36	*A*	ES6.B	2003
37	*A*	ES6.B	2003
38	*B*	ES6.C	2005
39	*D*	ES7.A	2004
40	*A*	ES7.A	2005
41	*C*	ES7.B	2003
42	*D*	ES8.A	2003
43	*A*	ES8.A	2005
44	*B*	ES8.B	2005
45	*C*	ES8.C	2003